IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Motohiro Itadani, et al.

Serial Number: 10/579,739 Group Art Unit: 2883

Filed: May 18, 2006 Examiner: MOONEY, MICHAEL P

For: LIQUID CRYSTAL DISPLAY DEVICE

DECLARATION UNDER 37 CFR 1.132

Commissioner for Patents
Washington, D. C. 20231

Sir:

The undersigned, Mitsuhito Hirota, declares as follows:

I am a National of Japan, residing at Kawasaki-shi, Japan. I am a Staff Chemist of Precision Optics Lab., Research and Development Center, ZEON Corporation which is located at 1-2-1, Yako, Kawasaki-shi, Kanagawa-ken, Japan.

I received a Doctor's degree in pyro-meta in 1994 from Waseda University. In 2003, I joined ZEON CORPORATION and worked on developing liquid apparatus.

I conducted the following supplementary experiments by computer simulation:

1. Object of the Experiment:

The object of the experiment is to obtain omni-directional contrast ratio of liquid display devices disclosed in the present invention US Serial Application No. 10/579,739 for comparison with the corresponding data for liquid crystal display disclosed in US Pat. Pub. No. 2003/0122991 A1 which is cited in the Office Action dated October 11, 2007.

2. Optical calculation

(1) System for simulation

In Itakura et al., it is disclosed that EZcontrast was used in measuring the viewing angle characteristics of the liquid crystal display. However, the EZcontrast was not available for the undersigned. Accordingly, LCD Master which is a calculation software soled by SHINTECH, Inc. was used. Method of calculation of LCD Master is based on 4×4 matrix method. The 4×4 matrix method is valuable for analyzing propagation of light through media such as liquid crystals or retardation films which exhibit optically anisotropic properties. Conditions for calculation for various optical elements will be set forth in the following.

(2) Conditions of Experiment

i) Liquid cell device

In the Examples disclosed in the present specification, a liquid crystal cell display device of in-plane switching mode having a thickness of 2.74 μm [ZL1-4792 manufactured by Merck Ltd] which has a birefringence Δn of 0.09884 measured at a wave length of 550nm was used to obtain a liquid crystal cell device having a pre-tilt angle of 0°. The liquid crystal cell device has a retardation Re of 275 nm. However, Itakura et al. fail to teach concretely what kind of liquid crystal device was used in their Examples. Only in [0049] on page 4 Itakura et al. disclose that the retardation Δn・d of the liquid crystal layer 13 used in EXAMPLE 1 OF FIRST EMBODIMENT is 310nm for the liquid crystal. It is not clear if this is applicable for all of the EXAMPLES of Itakura et al. However, of necessity, the undersigned decided to use same liquid crystal cell device ZL1-4792 in Comparative Examples 2 and 3 of this Supplemental Experiments except that the thickness thereof was changed to 3.14μm by calculation from the retardation disclosed in Itakura et al. and the birefringence value Δn of 0.09884 as set forth above.

ii) Polarizer

Characteristic value of polarizer in G1029DU in a database of LCD Master was used.

iii) Optical anisotropic member (optical compensator)

The refractive indices in the direction of fast axes of optical anisotropic member in the present specification or optical compensator in Itakura et al. was assumed to be 1.53 and the distribution with respect to wavelength was assumed to be flat.

3. Result

Fig. 9 shows a diagram exhibiting an arrangement of the liquid crystal display device used in Examples 1 to 5 of the present specification. In the figure,

reference numbers 1 and 5 each represents a polarizing plate, 2 represents a liquid crystal cell, 3 represents optical anisotropic member (A) and 4 represents optical anisotropic member (B), respectively. Table 1 shows properties of optical anisotropic member (A) and optical anisotropic member (B) used in Examples 1 to 5 of the present specification and omni-directional contrast of the liquid crystal display devices calculated in this experiment by simulation. The liquid crystal devices of Examples 1 to 5 falls within the scope of present claims 1 and 2. As seen from Table 1, the omni-directional contrasts of the liquid crystal display device used in Examples 1 to 5 show contrast values from >230 (Example 1) to >65 (Example 2). Table 2 shows properties of first and second optical compensators and omni-directional contrast ratios of the liquid crystal display of Itakura et al. obtained using the same system as used in obtaining the omni-directional contrast of the liquid crystal display devices of Examples 1 to 5 of the present specification.

Table 1

	Anisotropic Member (A)			Anisotropic Member (B)			OCR[1]
	R_e	R_{th}	Nz[3]	R_e	R_{th}	Nz	
Ex. 1[2]	90	-45	0	90	45	1.00	>230
Ex. 2	120	-25	0.29	50	25	1.00	>65
Ex. 3	70	-65	-0.43	50	70	1.90	>160
Ex. 4	120	-65	-0.04	50	70	1.90	>160
Ex. 5	70	-65	-0.43	110	70	1.14	>105

Notes

[1] OCR: Omni-directional Contrast Ratio

[2] Ex.: Example in the present specification

[3] Nz: (nx-nz)/(nx-ny) in Itakura et al.

Itakura et al. disclose 1st to 4th embodiments comprising various arrangements of liquid crystal layer, optical compensators and polarizers. Of these, the third embodiment has similar arrangement as that of the present invention in that two compensators (anisotropic members) are disposed between the liquid crystal layer and a polarizer at on side and no compensator (anisotropic member) is disposed between the liquid crystal layer and the polarizer at another side. Fig. 10 shows a diagram exhibiting an arrangement of the liquid crystal display disclosed in EXAMPLE 1-1 OF THIRD EMBODIMEBNT of Itakura et al. which is considered to exhibit best result in contrast ratio (>20, FIG. 14) of the

THIRD EMBODIMEBNT. In Fig. 10, reference numbers 31 and 32 each represents a polarizing plate, 13 represents a liquid crystal layer, 51 represents a first optical compensator and 52 represents a second optical compensator, respectively. Properties of 1st and 2nd compensators and omni-directional contrast ratio of the liquid crystal display of EXAMPLE 1-1 OF THIRD EMBODIMEBNT of Itakura et al. is summarized as Comparative Example 2. The omni-directional contrast ratio for Comparative Example 2 was found to be >42.

Table 2

	OC-1[1)]			OC-2			OC-3 and OC-4			OCR[3)]
	R_e	R_{th}	Nz	R_e	R_{th}	Nz	R_e	R_{th}	Nz	
CEX2[2)]	-320	-160	1.00	412	113	0.774	—	—	—	>42
CEX 3	-350	-224	1.14	274	-8	0.47	6[4)]	47	8.30	>55

Notes

1) OC: Optical compensator

2) CEX: Comparative Example in this experiment

3) OCR: Omni-directional Contrast Ratio

4) This value was changed from -6 as disclosed in Itakura et al. to 6 for the reason that the change gave a better result.

In addition to above, omni-directional contrast ratio for the liquid crystal display disclosed as EXAMPLE 2 OF FIRST EMBODIMEBNT of Itakura et al. was obtained and the result was shown as Comparative Example 3 in Table 2. EXAMPLE 2 OF FIRST EMBODIMEBNT of Itakura et al. is considered to give a liquid crystal display which exhibits the best results in contrast ratio (CR>200, FIG. 9) of all the EXAMPLES disclosed by Itakura et al., the arrangement of the liquid crystal display is different from the present invention, though. Fig. 11 shows a diagram exhibiting an arrangement of the liquid crystal display disclosed in EXAMPLE 2 OF FIRST EMBODIMEBNT of Itakura et al. In Fig. 11, reference numbers 31 and 32 each represents a polarizing plate, 13 represents a liquid crystal layer, 21 represents a first optical compensator, 22 represents a second optical compensator, 23 represents a third optical compensator and 24 represents a fourth optical compensator, respectively. Properties of 1st to 4th compensators and omni-directional contrast ratio of the liquid crystal display of EXAMPLE 2 OF FIRST EMBODIMEBNT of Itakura et al. is summarized as Comparative Example 3 in Table 2. In Itakura et al. the retardation of the third

and the fourth optical compensators were disclosed as -6 nm. However, in Table 2, this value was changed to 6 nm, because a better result of contrast ratio was obtained by changing from -6 nm to 6 nm.

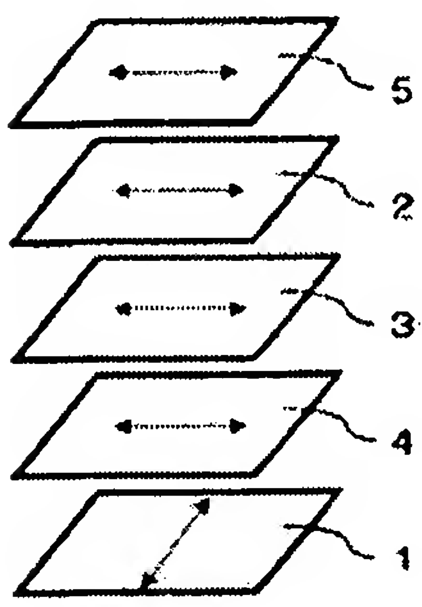

Fig. 9

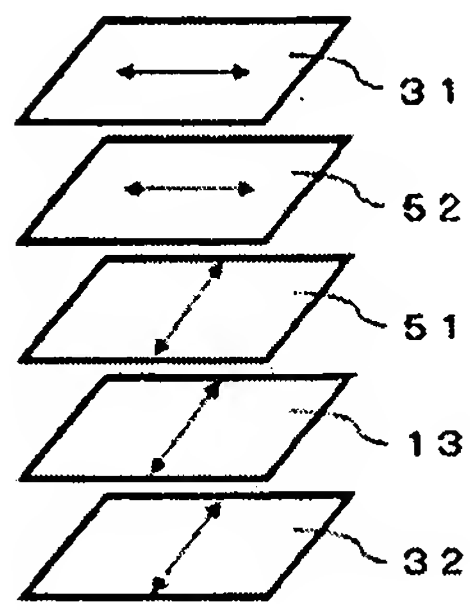

Fig. 10

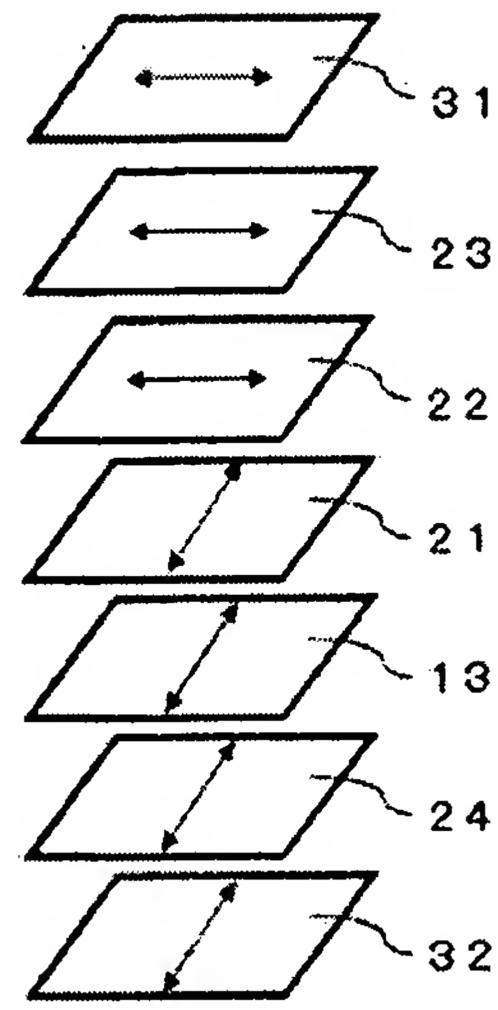

Fig. 11

4. Discussion

By comparing the omni-directional contrast ratio of Examples 1 to 5 shown in Table 1 which correspond to the liquid crystal apparatus claimed in present claims 1 and 2 of the present invention with those of Comparative Example 2 shown in Table 2 which were obtained for liquid crystal display of Itakura et al. fail having a similar structure as the liquid crystal apparatus claimed in present claim 1 and 2 except the difference in the direction of in-plane slow axes of the first and the second optical compensators, it is obvious that the liquid crystal display device of the present invention exhibits superior contrast over Itakura et al. fail

Furthermore, by comparing data of the liquid crystal display devices of Examples 1 to 5 of the present specification disclosed in Table 1 with the Comparative Example 3 in Table 2 which corresponds to a liquid crystal display as exhibiting a best result of contrast ratio of all of the EXAMPLES in Itakura et al. fail, it is found that the liquid crystal display device of presently claimed invention has an advantage in contrast over any EXAMPLES of Itakura et al.

5. Conclusion

It was confirmed that the omni-directional contrast of the liquid crystal display apparatus of presently claimed invention has advantage over that of the liquid crystal display of Itakura et al.

The undersigned declares that all statements made herein of his knowledge are true and all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that willful false statements may jeopardize the validity at the application or any patent issued thereon.

Signed this 4 th day of March, 2008

Mitsuhito Hirota

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